International Journal of Community Medicine and Public Health
Ravi T et al. Int J Community Med Public Health. 2024 Mar;11(3):1327-1338
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20240310

Case Series

Clinical assessment and patient education of chemical intolerance

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Received: 11 December 2023
Revised: 26 January 2024
Accepted: 31 January 2024

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ABSTRACT

Chemical intolerance (CI) is characterized by multi-system symptoms initiated by a one-time high dose or persistent low-dose exposure to environmental toxicants. Symptoms of this "medically unexplained illness" often include fatigue, headache, weakness, rash, mood changes, musculoskeletal pain, gastrointestinal, difficulties with memory, concentration, and respiratory problems. A general disease mechanism called toxicant-induced loss of tolerance (TILT) explains the initiation, symptoms, and intolerances to chemicals, foods, and medicines reported worldwide by individuals with this condition. TILT is a 2-stage disease process initiated by a major chemical exposure, or a series of low-level exposures, followed by multisystem symptoms and onset of new intolerances. Despite its prevalence of up to 20%, most primary care physicians are not aware of this disease process and thus have been unable to recognize patients with CI. This case series describes three family medicine clinic patients who had multisystem symptoms that were triggered by chemical exposures, saw multiple specialists with no improvement, who were eventually diagnosed with CI and went through a behaviorally based avoidance education program. This report describes the impact of a coordinated educational intervention for patients with CI. We offer several educational tools for health practitioners to discuss with their patients. These patient stories highlight the importance for physicians to be knowledgeable about CI in order to facilitate symptom reduction and improve the quality of life for these patients.

Keywords: CI, Patient education, Multiple chemical sensitivity

INTRODUCTION

Chemical intolerance (CI) is characterized by multi-system symptoms initiated by a 1-time high-dose/ persistent low-dose exposure to environmental toxicants. New-onset intolerances often occur upon subsequent exposures to structurally unrelated inhaled chemicals, foods and drugs.[1-3] Symptoms often include fatigue, headache, weakness, rash, mood changes, musculoskeletal pain, gastrointestinal, difficulties with memory, concentration and respiratory problems.[1-4] Most individuals attribute their illness to a well-defined exposure event, such as, exposures to pesticides, new construction or remodeling, indoor air contaminants, or a flood/water-damaged building resulting in mold and bacterial growth.[5-7] Prevalence estimates differ by whether it is clinically diagnosed (0.5-6.5%)/self-reported (average ~20%) in different population-based surveys.[8-12] There is evidence of increasing prevalence rates in the US and Japan over a 10-year period.[13,14]

Assessing CI most often involves use of quick environmental exposure and sensitivity inventory (QEESI), 50-item validated questionnaire designed to assess intolerances to inhaled chemicals, foods, and/ or drugs.[15] QEESI is validated, self-administrable questionnaire that has been used in over a dozen countries

around world and offers high sensitivity and specificity that differentiates CI individuals from general population.[16-18] Palmer et al for comprehensive list of 77 studies in 16 countries).[10]

The QEESI has four scales, but only the chemical exposure scale and symptom severity scale are used to assess for CI. The chemical exposure scale lists 10 potential exposures that may be problematic (e.g., engine exhaust, tobacco smoke, insecticides, gasoline, paint, cleaning products, perfumes, tar, nail polish, new furnishing/construction) and rates severity of intolerance (0="not a problem" to 10="severe or disabling problem"). Similarly, the symptom severity scale rates symptoms related to ten organ systems on a 10-point Likert scale (0=not at all a problem, 5=moderate symptoms, 10=disabling symptoms). Scores greater than or equal to 40 on both scales are very suggestive of CI. Scores from 20-39 on one or both scales are suggestive of CI. Scores less than 20 on both scales are not suggestive of CI.[17,18] Participants complete the symptom scale before and after interventions to evaluate symptom improvements. A Life Impact scale is also used to gauge the severity of CI on everyday activities such as shopping, the clothing one wears, and the places one goes. The QEESI is freely available at www.TiltResearch.org.

Origins of these various chemical, food and drug intolerances have historically been elusive and have incorrectly been attributed to classical toxicity, allergy, and/ psychological factors.[19-21] Notwithstanding, there is evidence for general disease process called TILT, which parsimoniously captures variety of symptoms and intolerances to chemicals, foods and medicines reported worldwide by researchers among individuals with this condition.[2,3,22,23]

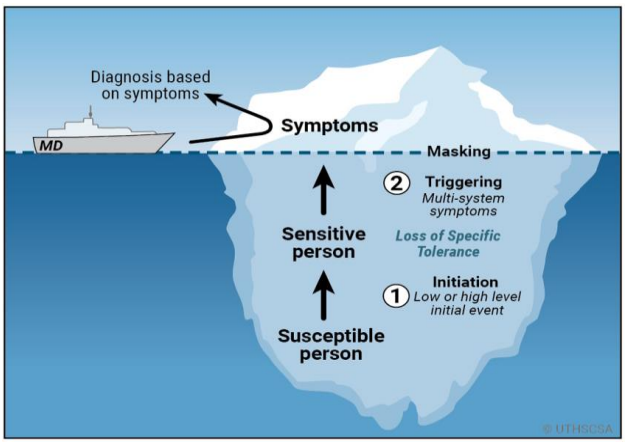

Figure 1: Toxicant induced loss of tolerance: Stage I and II.

TILT is a 2-stage disease mechanism initiated by a major exposure event/series of exposures (Figure 1). Initiating exposures include chemical spills, pesticides, cleaning agents, solvents, combustion products, drugs and medical devices, molds, and indoor air contaminants associated with construction/remodeling (Figure 2). Affected individuals often experience multi-system symptoms triggered by everyday chemicals, foods, and medications that never bothered them before and do not bother most people (Figure 3). Patients and clinicians who are unaware of 2-stage nature of condition often mistake the myriad triggers in stage II of TILT as causal and overlook stage I (relating to what initiated TILT).[1-4, 22, 23]

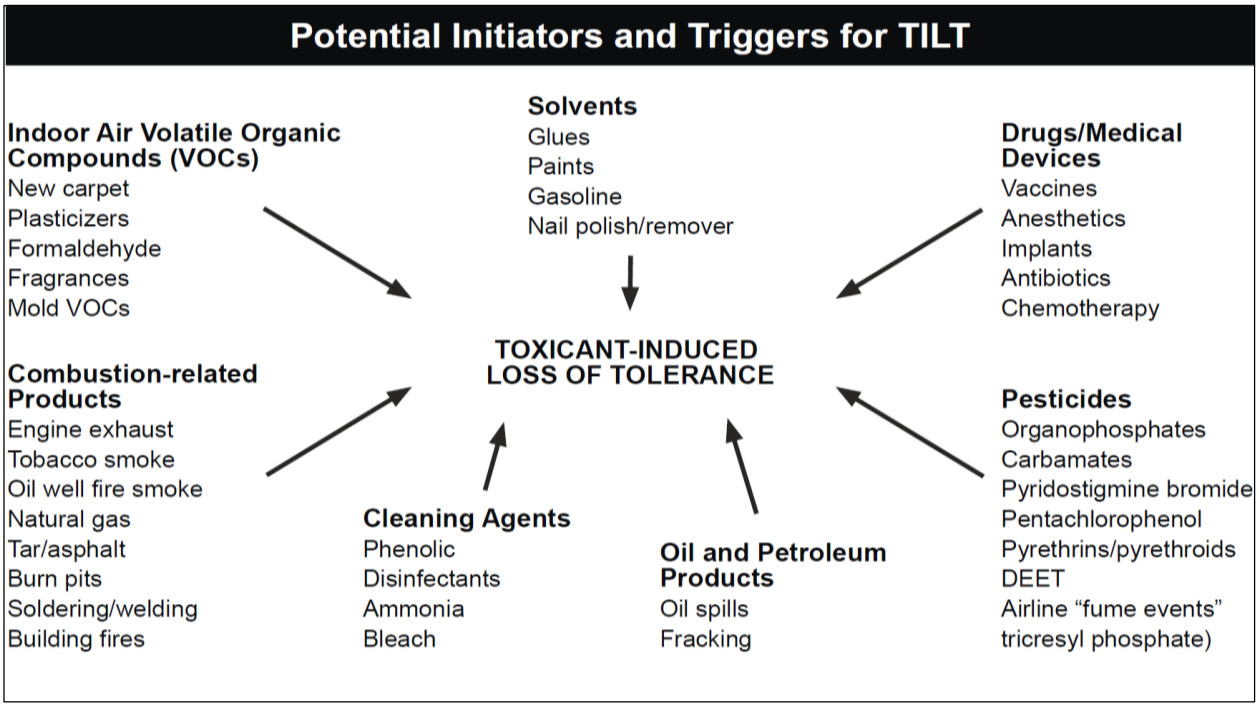

Figure 2: Potential initiators and triggers of toxicant induced loss of tolerance.

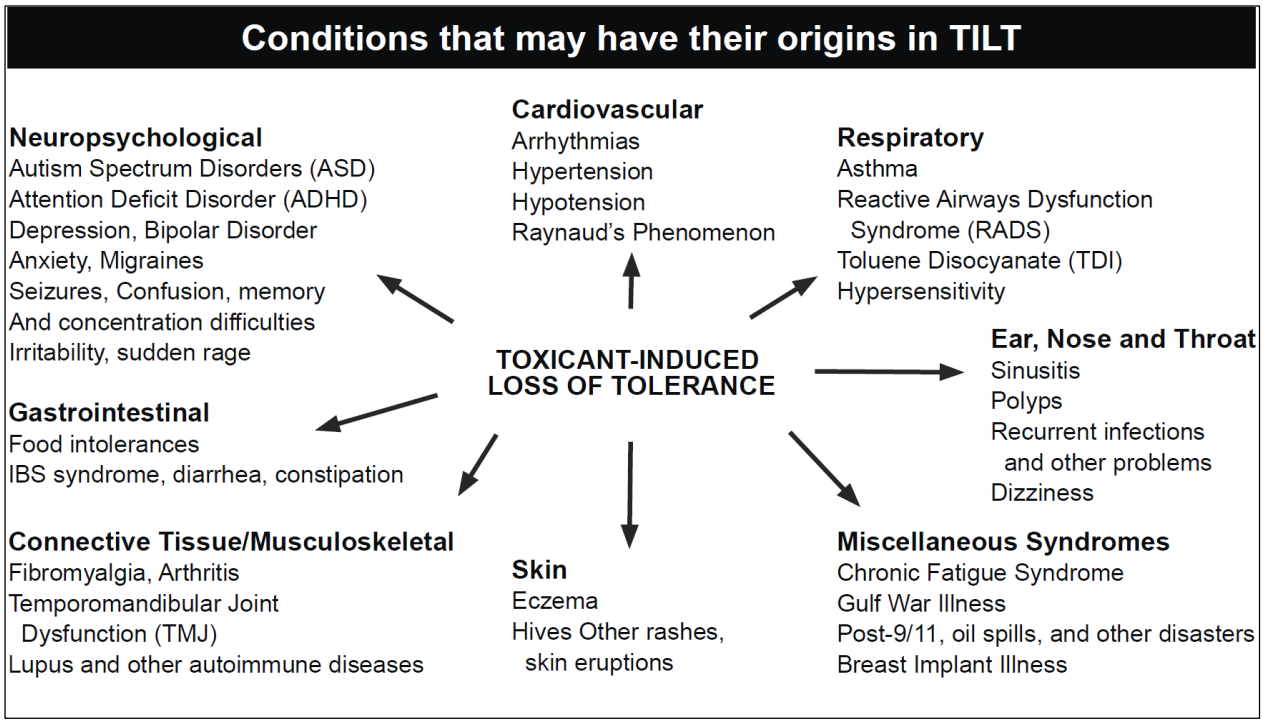

Figure 3: Conditions and symptoms of TILT.

Methodology used

The family health center CI clinic is a multidisciplinary clinic housed within the family health center, a continuity clinic for the family medicine residency at UT health San Antonio. This clinic is the first of its kind in the US and has been operating since August 2021. The CI Clinic treatment team consists of four family medicine physicians, one behavioral health consultant (licensed clinical psychologist), and three health educators. All team members have received extensive training in CI and its treatment by international experts in CI. All patients treated within the CI clinic complete an initial medical visit during which pertinent labs are ordered and a formal diagnosis is assigned. Patients are then provided a series of educational and behavioral health interventions, during which symptoms continue to be monitored.

The CI team has had prior success in reducing symptoms of CI through patient education consisting of identifying triggers in the home and/or the workplace, and teaching individuals with CI how to avoid these exposures.[24] These education sessions typically take between 5-7 sessions.

This report describes three family medicine clinic patients who had multisystem symptoms that were triggered by chemical exposures, saw multiple specialists with no improvement, and who were eventually diagnosed with CI. This case series will discuss patient symptoms, the assessment of CI, and the impact of educational interventions. These patient stories will highlight the importance for physicians to be knowledgeable about CI in order to facilitate symptom reduction and improve the quality of life for these patients. The patients in this case series gave informed consent, and our study was approved by UT health San Antonio's institutional review board (protocol number: 20200323HU). The study was funded by Marylyn Brachman Hoffman foundation, Fort Worth, Texas.

CASE SERIES

Case 1

A 75-year-old female nurse presented to the family medicine clinic with chronic headaches and fatigue. She had seen neurologists and multiple other physicians to find help for these symptoms but did not find a significant benefit from those visits. She was in her high school years when she first noticed headaches and pruritus after application of certain creams. She worked as a gynecology/oncology nurse in a radiation treatment unit in her 20s and 30s, and wonders if this exposure worsened her headaches and fatigue. Over the years, she noticed that exposure to scented candles, certain perfumes, fabrics, lotions, and laundry detergents triggered headaches, pruritus, and rash. Her intolerance to certain perfumes and lotions has sometimes prevented her from attending certain meetings and impaired her ability to function properly. Her chronic fatigue makes it difficult to perform daily activities.

Her past medical history includes cervical spine stenosis with bilateral upper extremity neuropathy, history of whiplash injury after a motor vehicle accident, chronic headaches (which began before the accident), colon cancer s/p hemicolectomy, and papillary thyroid cancer treated with radiation. She was also diagnosed with major

depressive disorder during the COVID-19 pandemic and was started on an SSRI. She does not smoke cigarettes, use alcohol, or do recreational drugs. Her lab work in August 2022 showed a normal comprehensive metabolic profile, complete blood count, thyroid stimulating hormone level, and hemoglobin a1c. Her ferritin in January 2022 and her vitamin B12 the previous year were normal. Her medications include hydrochlorothiazide, losartan, levothyroxine, sertraline, and esomeprazole.

Using the QEESI, she was diagnosed with CI in 2021. She had high QEESI questionnaire scores for chemical exposure (45/100), symptom severity (47/100), and life impact of sensitivities (35/100) (Table 1 and Figure 4) She subsequently received an educational intervention consisting of monthly sessions across seven months by the clinic's CI education team. She learned how to identify everyday chemicals (such as perfumes, lotions, and candles) that trigger her symptoms and learned about safe alternatives. She does live in an old house and would like to clean the attic and some other areas. However, she shares her home with her brother and needs to compromise on what changes can be made to their house. Being aware of her symptom triggers and avoiding/substituting them improves her symptoms.

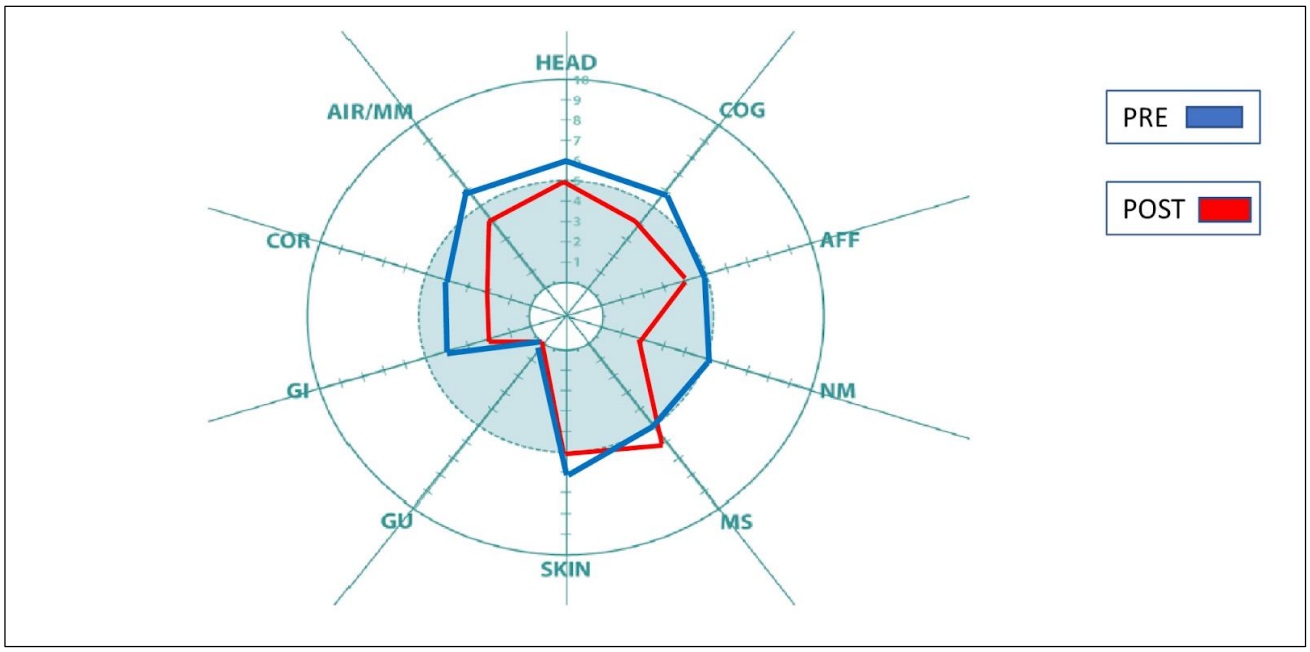

Figure 4: Case 1 symptom star: QEESI's symptom severity subscale score by organ system. Pre- and post-education about chemical intolerance (0=no symptom for that organ system, 10=high level of symptoms).

Table 1: Case 1: QEESI scores. Low, medium, and high scores are indicated for each subscale.

QEESI subscales	QEESI scores at diagnosis (2021)	QEESI scores at follow up after intervention (November 2022)
Chemical exposure score	45/100 (high)	38/100 (medium)
Symptom severity score	47/100 (high)	34/100 (medium)
Life impact score	35/100 (high)	25/100 (high)

In November 2022, she completed a follow-up QEESI questionnaire to monitor for any improvements. The chemical exposure and symptom severity scores improved to medium levels (38/100 and 34/100, respectively); the life Impact of her sensitivities also improved but still remained high (25/100) (Figure 4). She then had a consultation with a physician trained in CI in November 2022, and received a behavioral intervention delivered by the CI team's behavioral health consultant, a licensed clinical psychologist, in December 2022. The intervention with the behavioralist consisted of identification of barriers and facilitators to behavior change and goal setting. Additionally, this intervention reinforced what she knew about avoiding triggers and encouraged her to protect her personal space in her home and office, in order keep it clean and remove any chemicals that trigger her symptoms. In April 2023, she had a final visit with the behavioralist, who further engaged her in goal setting and identification of "red flags" (i.e., what would suggest she requires assistance from the CI team).

Case 2

A 53-year-old Black male presented with chronic multisystem symptoms including fatigue, brain fog,

nausea, headaches, acid reflux, difficulty concentrating, and anxiety. He had these symptoms since childhood. He had repeated exposures to household cleaning products that his mother used and remembers developing these symptoms after exposure to those chemicals. His symptoms worsened when he worked in the oil fields for 5 years in his 40s and where he was exposed to gasses and fumes. The current triggers of his symptoms include second-hand tobacco smoke exposure, common household cleaners, candles, and nail polish. When he compromises with his wife on the types of cleaning products she uses, his symptoms improve.

His past medical history includes multiple sclerosis with a history of optic neuritis (currently stable on medication), typhus requiring hospitalization, lumbar radiculopathy, diabetes mellitus type II, hypertension, benign prostatic hyperplasia, paroxysmal atrial fibrillation, acid reflux disease, and osteoarthritis of knees. His current specialist teams are neurology, cardiology, pain management, and orthopedics. Multiple specialist visits did not alleviate his symptoms, even though his chronic conditions were under control.

Patient was screened for CI in August 2022 in his family medicine clinic. He had high QEESI scores for chemical exposure (67/100), symptom severity (54/100), and life impact (25/100). A month later, he had his first CI clinician evaluation. That visit consisted of discussion of CI diagnosis and education on avoidance of symptom triggers/exposures. His labs and the status of his other medical conditions were reviewed. His hemoglobin a1c was stable at 7%, and his comprehensive metabolic profile, complete blood count, and his TSH were normal. Earlier that year, his vitamin D 25-hydroxy was low at 16 ng/ml, and his serum vitamin B12 was 323 pg/ml; he was on supplementation for both.

The patient began the monthly educational intervention with our CI educators on trigger/exposure avoidance for 6 months. One of the sessions was with the CI team's behavioral health consultant. This visit focused on assessing readiness to engage in behavior change to address CI and identifying barriers and facilitators to behavior change. The patient initially identified his spouse as the most significant barrier, as she did not have an adequate understanding of the patient's experience with CI. However, he also identified her as a facilitator, noting that she was willing to understand further and to compromise use of chemicals around the patient. For instance, the patient indicated that his spouse opted to use a separate room to get ready for the day and to use nail polish, so as to limit exposure to the patient. The behavioral health consultant reinforced the steps the patient had taken and engaged him in identification of additional steps and problem-solving to ensure follow through with his plan to continue behavior change.

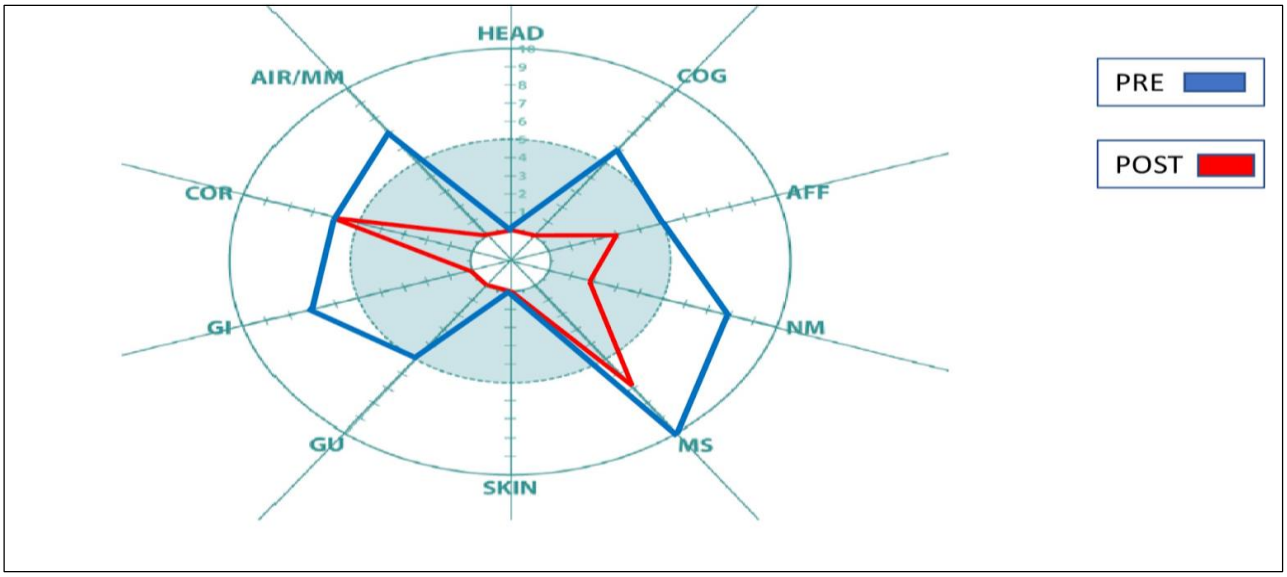

Figure 5: Case 2 symptom star: QEESI's symptom severity subscale score by organ system. Pre- and post-education about chemical intolerance (0=no symptom for that organ system, 10=high level of symptoms).

Table 2: Case 2: QEESI scores. Low, medium, and high scores are indicated for each subscale.

QEESI subscales	QEESI scores at diagnosis (August 2022)	QEESI scores at follow up after intervention (February 2023)
Chemical exposure score	67/100 (high)	49/100 (high)
Symptom severity score	54/100 (high)	10/100 (low)
Life impact score	25/100 (high)	8/100 (low)

By the end of the educational intervention, his QEESI scores were remeasured. His chemical exposure score remained high (49/100) but improved; and his symptom severity and life impact scores dropped drastically (10/100 and 8/100, respectively) (Table 2 and Figure 5). That the impact of sensitivities decreased significantly despite an elevated score on chemical exposures reflects the patient's ability to cope more effectively with CI, which is also an area of emphasis throughout the episode of care. During this 6-month period of educational intervention, his other medical conditions were stable.

Case 3

A 59-year-old family medicine clinic patient presented with chronic symptoms of nausea, dizziness, lightheadedness, confusion, irritability, and anxiety. She reports that she first experienced these symptoms when she worked at a Texaco truck stop where was exposed to industrial strength cleaning chemicals. Her current major symptom triggers are hand sanitizers, nail polish, household cleaners, and perfumes. She also reported smelling formaldehyde in her bedroom (old nightstand built in 1970), and often felt ill when the air conditioner at her apartment was running. Her past medical history includes type II diabetes (DM II) with retinopathy and neuropathy, morbid obesity, anxiety, panic disorder, bilateral knee arthritis, lumbar facet arthropathy, obstructive sleep apnea, tinnitus, migraines, and bilateral occipital neuralgia. She has seen neurologists for chronic migraines and occipital neuralgia and endocrinologist for her DM II. She has also had referrals to ENT and psychiatry. She denied any tobacco, alcohol, or illicit drug use. Her current medications include Novolog, Lantus, tramadol, ezetimibe, Lipitor, lisinopril, and vitamin B12 (borderline low vitamin B 12 of 273 pg/ml in 2018). Her hemoglobin A1c has been in the 7-8.7 percentages range. Her comprehensive metabolic panel and the complete blood count were normal, except for the slightly elevated glucose level. Her environmental allergen panel was negative in the 2017 at CI diagnosis.

She was first diagnosed with CI in February 2017. On her QEESI questionnaire, she had high scores for chemical exposure (45), symptom severity (53), and life impact (45). After her diagnosis, she was educated on the diagnosis and strategies on how to avoid symptom triggers, but after missing multiple appointments, she was lost to follow-up. A follow-up QEESI questionnaire administered to her in October 2017 showed some improvement in her symptom severity score (decreased to 34), but her chemical exposure and life impact score had worsened. She was then lost to follow up again throughout the first 1.5 years of the COVID-19 pandemic and she finally re-established care with the CI team in February 2022.

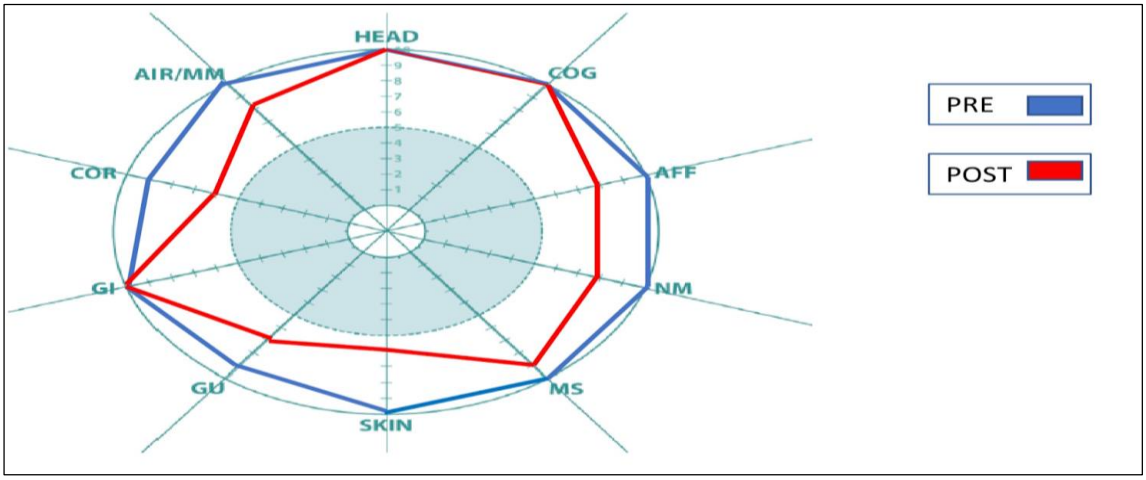

Figure 6: Case 3 symptom star: QEESI's symptom severity subscale score by organ system. Pre- and post-education about chemical intolerance (0=no symptom for that organ system, 10=high level of symptoms).

Table 3: Case 3: QEESI scores. Low, medium, and high scores are indicated for each subscale.

QEESI subscales	Scores at diagnosis (February 2017)	Scores at follow up after intervention (October 2017)	Lost to follow up during COVID-19 and COVID-19 infection	Scores (February 2022 re-established care)	Scores at follow up after intervention (February 2023)
Chemical exposure score	45/100 (high)	48/100 (high)		82/100 (high)	52/100 (high)
Symptom severity score	53/100 (high)	34/100 (high)		98/100 (high)	82/100 (high)
Life impact score	45/100 (high)	61/100 (high)		62/100 (high)	22/100 (medium)

When she re-established care in 2022, her QEESI worsened dramatically to very high scores. Her chemical exposure score was 82, symptom severity score was 98, and the life impact score was 62. She was seen by the CI team's behavioral health consultant in February and March 2022, once to introduce behavioral health services in the context of the CI clinic and once to assess readiness for behavior change to address CI and goal setting. She also underwent 7 monthly educational intervention sessions with CI educators in the subsequent months. She had a follow-up QEESI assessment in February 2023, which showed chemical exposure score of 52, symptom severity score of 82, and life impact score of 22; all high scores, but they show an improvement from February 2022. (Table 3 and Figure 6) The patient reports she is trying her best to avoid harsh cleaning solutions and perfumes, but she lives in an apartment complex and does not have control over the routine maintenance pest control sprays and apartment building cleaning products that the management uses.

DISCUSSION

Most clinicians are not familiar with CI despite a 20% prevalence found in the primary care setting and a 5-30% of the United States population reporting unusual medically unexplained intolerance to certain chemicals.[1,4,5] CI/TILT often co-occurs with other disorders (such as fibromyalgia, chronic fatigue syndrome, and irritable bowel syndrome) and symptoms can be mistakenly attributed to other diseases.[26] Often, exposures that initiated CI in a susceptible patient may not even be present anymore in the patient's environment; but the patient's symptoms continue to be triggered by other everyday chemicals around them and this confounds their physicians. Typical CI patients have seen multiple specialists without a clear diagnosis and are often frustrated with their medical care. This was the case in all three of the patients discussed here. After the diagnosis of CI, the patients felt validated and were equipped with some practical tools to reduce or eliminate their symptoms.

The primary treatment of CI involves removing or reducing chemicals that trigger symptoms. For our case 1 patient, his symptoms and the life impact of his symptoms significantly improved after the identification and elimination of his symptom triggers. However, many patients are limited in their ability to control/change their environment. This was the case for our case 2 and case 3 patients; although their symptom severity and the impact on their life improved after CI education, they did not reduce to low levels. They both had some elements in their environment that they could not control. Our Case 1 patient lived with her brother with whom she needed to negotiate household changes. Our case 3 patient lived in an apartment community and needed to negotiate with her landlord/apartment management. Compromises and negotiations with co-habitants, co-workers and landlords often involve removing triggers from the home which others may value or want to continue using, for example, plug in air-fresheners, perfumes, and other scented personal care items.

Another challenge in the treatment of CI is its lifelong chronicity. It requires a strong commitment to maintaining the changes made in the environment to reduce/eliminate symptom triggers. Life stressors often can interfere. For example, our case 3 patient was lost to follow up during the COVID-19 pandemic during which she was mainly homebound and isolated in an apartment that was the source of most of her symptom triggers (this could explain the significant worsening of her symptoms between 2017 and 2022). Having a team to encourage these patients on a regular basis and help them troubleshoot new triggers is essential.

An interprofessional team of trained CI educators can screen patients for CI, help patients recognize symptoms, and can even perform environmental house calls to help pinpoint chemicals that can trigger the patient's symptoms.[24] Symptoms may resolve or improve with the avoidance of chemical, dietary (including caffeine and alcohol), and drug triggers. Recognizing CI and helping patients identify everyday triggers of their constellation of symptoms can decrease their symptoms and improve quality of life. Primary care clinicians view individuals holistically and are uniquely prepared to recognize and intervene when home exposures may contribute to illness, for example, in the case of lead paint in older homes or poor indoor air quality/exchange, which can be invisible contributors to illness.[27] Further, behavioralists are able to work with patients toward behavior change, working through barriers, and/or to cope with aspects of management that might be outside of an individual's control.

Home interventions for asthma and allergies have received the most recognition; however, despite mounting evidence of adverse effects on health, the importance of indoor volatile organic compounds or VOCs (especially for susceptible populations) remains understudied and underappreciated.[28,29]

Individualized house calls or air quality monitoring in the home may not be practical in a standard medical practice, however, there are simple tools available that can be employed to help patients. Designed for busy office practices, the brief environmental exposure and sensitivity inventory (BREESI) is an internationally validated 3-item 1-minute screener for CI.[10,30,31] Our research has shown that 97% of persons answering "Yes" to all three items on the BREESI had high CI scores as assessed by the larger 50-item QEESI. Ninety-five (95%) of those who answered "No" to all of the BREESI items, showed no evidence of CI on the QEESI. Any individual answering "Yes" to one or more of the three BREESI screening items should then take the full QEESI at www.TILTresearch.org. The QEESI is a practical clinical tool for assessing symptoms, chemical and other intolerances, and their life impact. Patients can be counseled to avoid salient exposures and

track any health changes using the symptom star, as demonstrated here.

Table 4: Common findings in homes that may be chemical intolerance symptom triggers.

Fragranced personal care products	Household products	Scented household products
Soaps	Floor and surface cleaners	Laundry products
Shampoos	Paints/thinners	Detergents
Deodorants	Fragrance-emitting devices (air fresheners and plugins)	Fabric softener
Cosmetics	Scented candles/ incense	Dryer sheets
Oral hygiene products	Insect repellents	
Hair spray and other hair products	Pesticides	
Lotions/oils	Fragranced garbage/trash bags	
Perfumes/cologne		
Nail polish/ remover		

Other resources to aid clinicians in assisting patients with CI are available online (https://TILTresearch.org/). Although further research is needed to support the clinical value of assessing intolerances and intervening in the home, the general advice is to reduce VOC home exposures and should be considered basic preventive practice given in the spirit of the precautionary principle (e.g., adopt precautionary measures when scientific evidence about an environmental health hazard is uncertain but the stakes are high).[32] We have found that the homes of individuals with CI contain a wide range of products that release VOCs (Table 4). While remediating an entire household can be challenging and expensive for most, some CI patients have benefitted from designating one or more rooms as a 'clean air oasis' where exposures and sources are minimized. As such, we have produced the guide '7 steps to creating a clean air oasis' and safer cleaning "recipes". For these and other recommended resources see appendix material A1-A5.

CONCLUSION

Most clinicians are not familiar with CI despite a 20% prevalence found in the primary care setting and a 5-30% of the United States population reporting unusual medically unexplained intolerance to certain chemicals. This report describes the impact of a coordinated educational intervention for patients with CI. We offer several educational tools for health practitioners to discuss with their patients. These patient stories highlight the importance for physicians to be knowledgeable about CI in order to facilitate symptom reduction and improve the quality of life for these patients.

ACKNOWLEDGEMENTS

The authors would like to thank the Marilyn Brachman Hoffman foundation for their continued support, and to all those struggling with chemical intolerance.

Funding: Marylyn Brachman Hoffman Foundation, Fort Worth, Texas
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Ravi T, Johnson-Esparza Y, Hernandez J, Andry N, Ali F, Villacampa MDPM et al. Clinical assessment and patient education of chemical intolerance. Int J Community Med Public Health 2024;11:1327-38.

APPENDIX

A1: Clean air oasis

7 steps to creating a clean air oasis

We spend 90% of our day indoors where the air often is more polluted than the air outside.

Research suggests that a "clean room" may help people who suffer from breathing difficulties, allergies, headaches, brain fog/confusion, fatigue and other health problems. You can create a clean air oasis in your home or in one room, where the air is as free as possible of chemicals, smoke, fragrances, and allergy triggers.

Figure 1: Clean air oasis.

1. Pick a room

Choose the room where you spend most of your time, usually your bedroom. Bring in fresh air whenever possible.

2. Eliminate air pollutants

Remove all products that have strong odors such as cleaning and laundry products, pesticides, perfume/cologne, scented lotions, deodorants, cosmetics, candles, air fresheners, and aerosols like hair spray which form tiny droplets that are easily inhaled.

3. Do not permit pets inside the oasis

Furry pets can trigger asthma, allergies, and other problems.

4. Clean safely

Use only fragrance-free products for cleaning and doing laundry. Cleaning and vacuuming are best done when sensitive individuals are not in the immediate area. Ventilate during and after cleaning.

5. Avoid burning anything indoors

Smoke and combustion gases irritate the lungs. Do not permit smoking, vaping, or candle- or incense-burning. Do not use fireplaces, open-flame gas heaters or unvented water heaters. Prevent carbon monoxide poisoning—never heat your home using a gas stove, gas oven, or Hibachi. If you move or purchase new appliances, electric stoves and other appliances are the better health option.

6. Go the extra mile

An air purifier with HEPA and charcoal filters can remove pollutants. Keep it running while the room is occupied, including overnight. Bring in fresh outside air whenever possible.

7. Learn more

Many of our choices affect the air we breathe indoors. Learn how to remove fragrances from fabrics, stop pests without using pesticides, control humidity and mold, and find safer products for home repair/remodelling. Visit https://makelivesbetter.uthscsa.edu/tilt for more information.

A2: Suggested educational resources to help identify and reduce home exposures

Environmental working group: https://www.ewg.org/healthyhomeguide/, TILT website: https://tiltresearch.org/about-tilt/triggers-prevention/,

EPA: https://www.epa.gov/indoor-air-quality-iaq/protect-indoor-air-quality-your-home

https://www.epa.gov/indoor-air-quality-iaq/interactive-tour-indoor-air-quality-demo-house

https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality

IAQA: https://iaqa.org/consumer-resources/5-easy-tips-to-get-a-healthy-home/

USDA's Healthy Homes Partnership: https://extensionhealthyhomes.org/ccontent.html

A3: Different levels of intervention that can be customized for different situations

Level 1: Can be used in any clinic. Administer the 3-item BREESI CI screener and the QEESI to individuals who might benefit from improved indoor air quality.[10,30,31] Provide educational resources to help identify and reduce home exposures and symptom triggers. Periodically, follow up using QEESI Symptom Scale to evaluate symptom improvement.

Level 2: Plans include the creation of a home environment oasis, an area or room in the home where the patient spends most of the day, typically the bedroom, where air quality can be optimized. Optimization may require HEPA filtration to remove fine particles and activated charcoal filters to remove VOCs.

A4. Brief environmental exposure and sensitivity inventory (BREESI)

Designed for busy office practices, the BREESI is an internationally validated 3-item screener for CI.[10,30,31] Our research revealed that 97% of persons answering "Yes" to all three items on the BREESI had high CI scores as assessed by the QEESI. If two items were endorsed, approximately 84% of the sample had high CI scores. If one item was endorsed, 48% had high CI scores. 95% of those who answered "No" to all of the BREESI items, showed no evidence of CI on the QEESI. Any individual answering "Yes" to one or more of the three BREESI screening items should take the full QEESI at www.TILTresearch.org.

Instructions: Please answer these three questions by checking 'Yes or No'

1. Do you feel sick when you are exposed to tobacco smoke, certain fragrances, nail polish/remover, engine exhaust, gasoline, air fresheners, pesticides, paint/thinner, fresh tar/asphalt, cleaning supplies, new carpet or furnishings? By sick we mean: headache, difficulty thinking, difficulty breathing, weakness, dizziness, upset stomach, etc.

□*Yes* □*No*

2. Are you unable to tolerate or do you have adverse or allergic reactions to any drugs or medications (such as antibiotics, anesthetics, pain relievers, X-ray contrast dye, vaccines or birth control pills), or to an implant, prosthesis, contraceptive chemical or device, or other medical/surgical/dental material or procedure?

□*Yes* □*No*

3. Are you unable to tolerate or do you have adverse reactions to any foods such as dairy products, wheat, corn, eggs, caffeine, alcoholic beverages, or food additives (e.g., MSG, food dye)?

□*Yes* □*No*

A5. Common triggers, consider the alternative option

Table: Common triggers, consider the alternative option.

Instead of using	Try this
Pesticides (indoors or on lawns) or mothballs	Baits or traps
Paints, varnishes, glues, polishes with high solvent content	Low- or no-solvent content paints, water-based finishes and glues
Bleach, ammonia, disinfectants and strong cleaning products	Elbow grease, non-toxic soap and water, baking soda and vinegar
Scented products, perfumes, air fresheners, incense	Unscented cleansers, laundry detergent, fabric softeners and cosmetics
Hair coloring, permanents, hair spray, other aerosols	New haircut, hair gel, or spray-free styling products
Dry cleaning, odorous soft plastic toys, mattress covers	Washable toys, bedding and clothing
Vinyl, pressed wood or particle board, carpeting (traps allergens)	Ceramic, stone tile or hardwood floors
Commercial foods that contain pesticides or other questionable ingredients	Organic foods and foods without additives or artificial colors/flavors
Tap water	Filtered water